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ABSTRACT

This booklet was designed to supplement existing classroom studies on the subject of the solar system at the primary level. Science and mathematics activities for studying moons, planets, and space craft are presented. (PR)

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PRIMARY PLANETS AND ELEMENTARY MOONS

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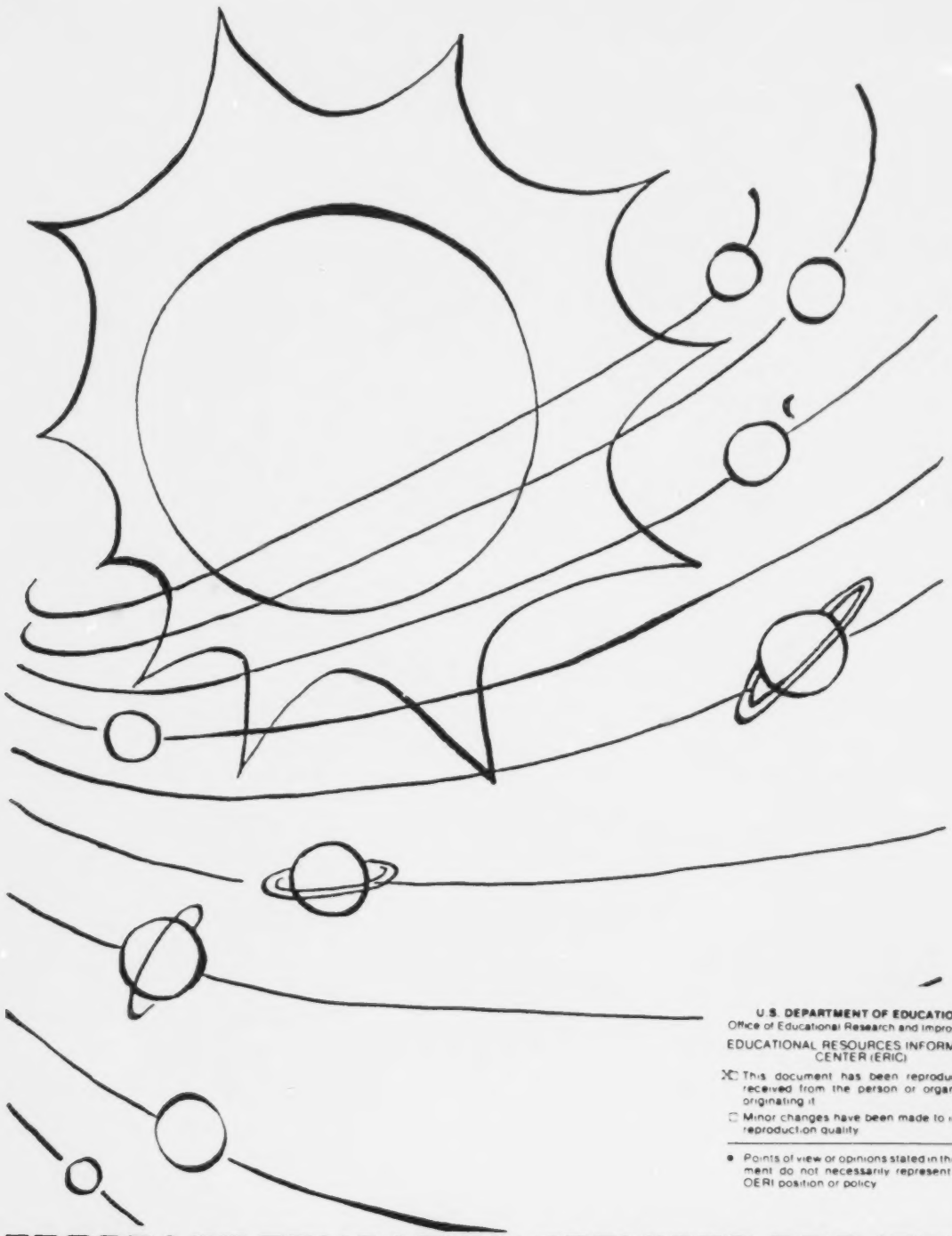

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SOME FIGURES ON THE PLANETS

	MERCURY	VENUS	EARTH	MARS	JUPITER	SATURN	URANUS	NEPTUNE	PLUTO
AU	0.387	0.723	1.000	1.524	5.203	9.523	19.164	29.987	39.37
SIDEREAL PERIOD	88.0 d	224.7 d	1.000 y	1.88 y	11.86 y	29.46 y	84.01 y	164.1 y	247 y
INCL. TO ECLIPTIC	7°00'	3°24'	defines ecl.	1°51'	1°18'	2°29'	0°46'	1°47'	17°10'
MASS*	.055	0.8150	1.00	0.1074	317.9	95.2	14.6	17.2	.0019?
SURFACE GRAVITY*	0.378	0.91	1.00	0.379	2.339	0.925	0.849	1.140	.041?
EQ. RADIUS (mi)	1,516	3,759	3,963	2,111	44,492	37,824	15,970	15,380	932?
RADIUS	0.31	.91	1.00	0.532	11.89	9.4	4.03	3.9	0.204?
MEAN DENSITY (g/cm^3)	5.44	5.269	5.517	3.945	1.314	0.704	1.21	1.66	0.8?
ROTATION (Synodic)	176.0d	116.7d	24h	24h39m35s	9h55m33s	10h14m	17h	16h6.7min	6d9h18m?
(Sidereal)	58.6d	243.0d	23h56m4s	24h37m23s	9h55m30s	same	same	same	same
INCLINATION OF EQ. (to orbit)	near 0°	17.5°	23.45°	25.2°	3.1°	26.7°	97.9°	28.8°	?
SATELLITES	0	0	1	2	16	21+	15	8	1
Discovered by:							Herschel	Adams Leverrier	Tombaugh
Date Discovered							1781	1846	1930

* Compared to Earth

AU - Astronomical Unit- Equivalent to Earth-Sun distance (~ 93 million miles) thus Earth is 1 AU from the Sun.

Synodic- length of Solar day, or average time for successive passages of the Sun, overhead as would be seen from the planet.

Sidereal- length of stellar day, or average time for successive passages of same star overhead as would be seen from the planet.

PRIMARY PLANETS AND ELEMENTARY MOONS

ACTIVITIES FOR PRIMARY STUDENTS

THE BETTER WE UNDERSTAND THE SOLAR SYSTEM
THE BETTER WE UNDERSTAND OURSELVES

The following material was designed to supplement your existing classroom studies on a primary level with the subject of our solar system.

Special thanks to Sister M. Sylvia Schik, Crosier Seminary, Onamia, Minnesota.

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1983

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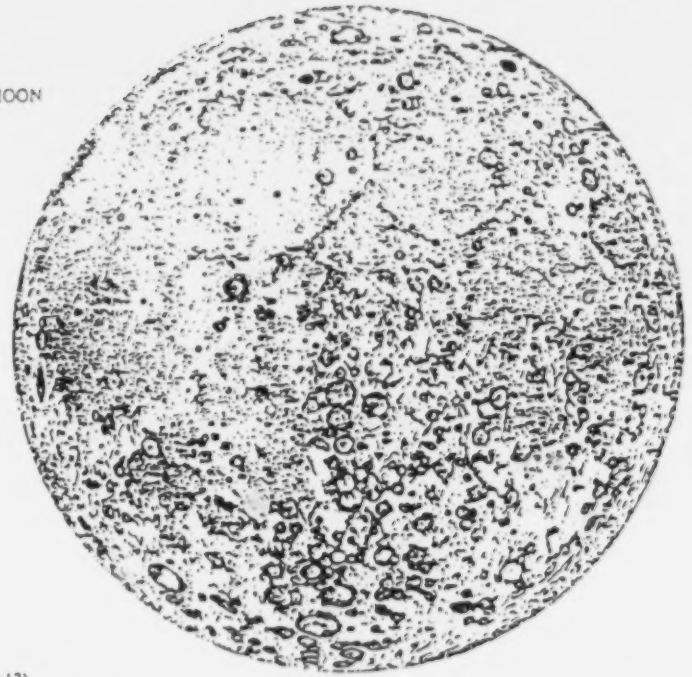
MOON

KEY TO THE MAP OF THE MOON



CRATERS

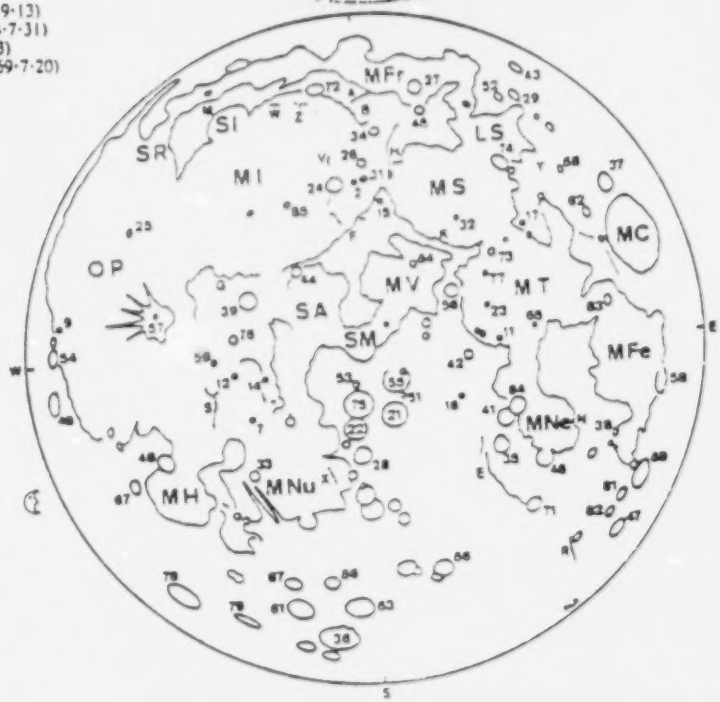
21—Albategnius
22—Alphonsus
23—Arago
24—Archimedes
25—Aristarchus
26—Aristillus
27—Aristoteles
28—Arzachel
29—Atlas
31—Autolycus
32—Bessel
33—Bullialdus
34—Cassini
35—Catharina
36—Clavius
37—Cleomedes
38—Cook
39—Copernicus
41—Cyrillus
42—Delambre
43—Endymion
44—Eratosthenes
45—Eudoxus
46—Fracastorius
47—Fumerius
48—Gassendi
49—Grimaldi
51—Hailey
52—Hercules
53—Herschel
54—Hevelius
55—Hipparchus
56—Julius Caesar
57—Kepler
58—Langrenus
59—Lansberg
61—Longomontanus
62—Macrobius
63—Maginus
64—Manilius
65—Maskelyne
66—Maurolycus
67—Mersenius
68—Newcomb
69—Petavius
71—Piccolomini
72—Plato
73—Plinius
74—Posidonius
75—Ptolemaeus
76—Reinhold
77—Ross
78—Schickard
79—Schiller
81—Snellius
82—Stevinus
83—Taruntius
84—Theophilus
85—Timocharis
86—Tycho
87—Wilhelm

MOUNTAINS

A —Alpine Valley
B —Alps Mts.
E —Altai Mts.
F —Apennine Mts.
G —Carpathian Mts.
H —Caucasus Mts.
K —Haemus Mts.
M—Jura Mts.
N —Pyrenees Mts.
R —Rheita Valley
S —Riphaeus Mts.
V —Spitzbergen
W—Straight Range
X —Straight Wall
Y —Taurus Mts.
Z —Teneriffe Mts.

LUNAR PROBES

2—Luna 2, First to reach Moon (1959·9·13)
7—Ranger 7, First close pictures (1964·7·31)
9—Luna 9, First soft landing (1966·2·3)
11—Apollo 11, First men on Moon (1969·7·20)
12—Apollo 12 (1969·11·19)
14—Apollo 14 (1971·2·5)
15—Apollo 15 (1971·7·30)
16—Apollo 16 (1972·4·21)
17—Apollo 17 (1972·12·11)



MARIA

LS —Lacus Somniorum (Lake of Dreams)
MC —Mare Crisium (Sea of Crises)
MFe —Mare Fecunditatis (Sea of Fertility)
MFr —Mare Frigoris (Sea of Cold)
MH —Mare Humorum (Sea of Moisture)
MI —Mare Imbrium (Sea of Rains)
MNe—Mare Nectaris (Sea of Nectar)
MNu—Mare Nubium (Sea of Clouds)
MS —Mare Serenitatis (Sea of Serenity)
MT —Mare Tranquillitatis (Sea of Tranquillity)
MV —Mare Vaporum (Sea of Vapors)
OP —Oceanus Procellarum (Ocean of Storms)
SA —Sinus Aestuum (Seething Bay)
SI —Sinus Iridum (Bay of Rainbows)
SM —Sinus Medii (Central Bay)
SR —Sinus Roris (Bay of Dew)

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CHILDTALK

We all know that children sometimes say the ------- things, and sometimes we realize we are listening to ourselves in their words. The following exercise is along those lines.

Directions: Age level--K, 1
Have the students define the following terms.
Record your answers. Post.

TERMS:
- Space
- Moon
- Astronaut
- Pluto
- The sun

QUESTIONS:
- How do you build a rocket?
- How does a rocket work?
- What should you take with you for a week in space travel?
- What are stars?

SOLAR FAMILY SCALES

The following numbers represent the average distance in miles from the earth to the various members of the solar system.

Sun	93,000,000	Jupiter	400,000,000
Mercury	57,000,000	Saturn	800,000,000
Venus	26,000,000	Uranus	1,680,000,000
Moon	230,000	Neptune	2,698,000,000
Mars	48,000,000	Pluto	2,670,000,000 (in 1986)

At an average speed of walking at 5 MPH, how long would it take to reach the following objects? Watch your units. Convert the days into years whenever possible.

Moon _____

Mars _____

Venus _____

Let's increase our speed to 55 MPH. How long would it take to drive to:

Moon _____

Mars _____

Sun _____

Venus _____

If we could take a jet plane at 500 MPH, how long would it take to reach the following objects? Watch your units. Convert the number of days into years whenever possible.

Moon _____

Mars _____

Mercury _____

Venus _____

Jupiter _____

Saturn _____

Uranus _____

If we could reach these objects, how long would a radio message take to reach earth?

Venus _____ Mars _____

Uranus _____ Pluto _____

Jupiter _____ Mercury _____

Saturn _____ Neptune _____

LUNAR ODDS AND ENDS

When was the last time you looked at the moon? Perhaps it was during its so-called "full" phase. Pretty bright, wasn't it?

Not really. We are fooled? Our moon has an albedo of .07. Albedo is a term used to reflect (no pun), that is, to express how much light is reflected by an object. A mirror, if perfect (none are), would reflect all the light hitting it and would have an albedo of 1.00. A true black surface would reflect none and have an albedo of .000,000. So our moon reflects about as much light as county trunk road A (as in asphalt), which makes it one of the poorest reflectors in the Solar System.

How about a sky full of moons? First of all, there would be lots of spaces so we will have to chop them a bit to stack up. It would take more than 100,000 of our moons to fill the sky. And if we did, would they provide as much light as the sun? Not quite -- all of these moons would give you one-quarter the light of the noonday sun.

A full Earth is 50 times brighter than a full moon. But this fact is only relevant to people living on the moon (Selenites), or to people just visiting there. H.G. Wells called people who live on the moon "Selenites".

Speaking of living on the moon, from there the moon, too, goes through phases. But unlike the Earth it doesn't rise and set. It goes through its phases suspended in place in the black sky of space. This fact made it very easy for the Apollo astronauts to talk to people on Earth.

For years, navigation on the Earth was made possible by locating the North Star. However, given enough time, this star changes. The ancient Egyptians had a different star to look at. This is because the Earth has a slow wabble to its movement through space. The complete cycle of this wabble takes some 26,000 years and this movement is referred to as "precession". Every 26,000 years you get the same star.

The moon, too, has a precession, but the complete cycle takes only 18½ years.

Navigation on the moon for future Selenites will be interesting. There is the problem of precession, and the fact that the moon has no magnetic field, so a compass will not be of any use.

The total mass of the moon is 1/83 that of the Earth. Your weight on the moon is therefore less than on Earth. The mathematics are not simple, but the fact is that on the moon, you weigh 1/6th of what you do on Earth.

LUNAR ODDS AND ENDS (continued)

Ever wonder how long it takes to go from one full moon to the next? Roughly 29 days, or 29.53059, to be exact. This is a lunar month, or a Synodic month, and it was a very important measurement in setting up the system of calendars we use today.

As we look at the moon at different times of the month we notice its phases. The reason is simple. The moon is in orbit around the Earth and at different times is leading us or following us as we, in turn, orbit the sun. When we see the first quarter moon in the western sky, we see the moon in front of us; we see where the Earth was 3½ hours ago in its trip around the sun. When we look at the last quarter early in the morning, we are looking at where we will be in 3½ hours. When we look at the full moon, we look at where we will never be!

Perhaps the romance of the moon has lost something since we've stepped on it. It seems they just don't write about it anymore. But our appreciation for this object should not decrease, for now the mountains and seas and hills and rocks are no longer strangers. If anything, we've gained a new heritage. Enjoy.

LUNAR ODDS AND ENDS WORKSHEET

1. Which is brighter -- a sky full of full moons or the sun?

2. Why won't a compass do you any good on the moon?

3. John weighs 20 pounds on the moon. How much will he weigh in Boston?

4. It is July 10 and the moon is full. When will the next full moon occur?

5. Draw the phases of the moon as it orbits the Earth. Be sure to place the Earth in the center. Show full, last quarter, first quarter, and new.

6. What is precession? Have you ever seen one?

7. Find out when the next full moon occurs. If you were on the moon at that time, what do you think the Earth would look like?

8. If you were on the moon looking at the full Earth, would it be lunar day or lunar night?

9. Can you ever have a month without a full moon? Explain.

10. There was an old, unscientific joke that said the moon was made of green cheese. If it were, would it be brighter than it is now? (Assume we are talking about a full moon.)

LUNAR BASE -- 2010

The following activity requires group interaction among four to six students. These students will establish a lunar base to house 20 to 50 people, but the base should be capable of growth to over 100 people.

ASSIGNMENT:

Select a potential site from a lunar map. It is advised you stick to one of the mares, or sea areas, of the moon as they have less relief and would be easier for adaptation. But--don't let that stop you; perhaps some of the highlands or mountains have mineral wealth and your base could be a lunar mine operation.

Lay out your base and include these necessities:

Power	Communications area	Schools
Housing	Hospitals	Greenhouse (food crops)
Work areas	Spaceport	

Recreation (remember that 1/6th g means different sports; a baseball or golf ball would travel much farther. Perhaps you could design a par 3 golf course.)

ACTIVITIES:

-Sketch the location of each structure.
-Blueprint the layout of each structure.

OR

-Make a model of each structure using shoeboxes or other cardboard containers.

Don't forget to name your base. Indicate its location on a map of the moon. Name the individual buildings, too!

Remember all living things must be protected from:

-Extreme temperature differences between day and night.
-Micro meteorite impacts.
-Solar flares.

As a result of these hazards, the final project will be buried under six feet of lunar soil. So be sure to include the gravel pit area.

A DRIVE TO THE MOON

Did you ever wonder how far away the moon is? How long it would take you to get there, and how much it would cost if you could simply get in a car and drive it?

Given the average distance to the moon of 240,250 miles, you can use the following chart to see how the family car would do on a trip to the moon. Simply multiply the number of gallons listed on the chart by the current price of gas.

How long would it take you to drive to the moon? Assuming you drive at the legal freeway speed of 55 miles per hour, it would take you 4368 hours, or about 182 days to cover that distance.

Miles per gallon	Number of gallons	Miles per gallon	Number of gallons
9	26,694	26	9,240
10	24,025	27	8,898
11	21,840	28	8,580
12	20,020	29	8,284
13	18,480	30	8,008
14	17,160	31	7,750
15	16,016	32	7,508
16	15,015	33	7,280
17	14,132	34	7,066
18	13,347	35	6,864
19	12,644	36	6,673
20	12,012	37	6,493
21	11,440	38	6,322
22	10,920	39	6,160
23	10,446	40	6,006
24	10,010	41	5,860
25	9,610	42	5,720

For example, Mr. Hartsfield owns a 1982 car that gets 19 miles per gallon. That means he will use 12,644 gallons of gas. Given the present price of gas as being 97¢ per gallon, it will cost him 12,644 times $0.97, or $12,264.68 -- a bunch of cash! So calculate your family car's gas mileage and see how much it costs to reach the moon.

YOUR CAR

Miles per gallon _____

Number of gallons _____

Cost per gallon _____

Total cost _____

RUN TO THE MOON

Time to run 50 meters	Speed	Time to reach the Moon	Time to run 50 meters	Speed	Time to reach the Moon
seconds	m/sec	days	seconds	m/sec	days
1	50	89	26	1.92	2327
2	25	179	27	1.85	2415
3	16.67	268	28	1.79	2496
4	12.50	357	29	1.72	2597
5	10.00	447	30	1.67	2675
6	8.33	536	31	1.61	2770
7	7.14	626	32	1.56	2859
8	6.25	715	33	1.52	2949
9	5.56	804	34	1.47	3038
10	5.00	894	35	1.42	3127
11	4.55	982	36	1.39	3217
12	4.17	1071	37	1.35	3306
13	3.85	1160	38	1.32	3395
14	3.57	1251	39	1.28	3484
15	3.33	1342	40	1.25	3574
16	3.13	1427	41	1.22	3663
17	2.94	1520	42	1.19	3753
18	2.78	1607	43	1.16	3842
19	2.63	1699	44	1.14	3932
20	2.50	1787	45	1.11	4021
21	2.38	1877	46	1.09	4110
22	2.27	1968	47	1.06	4200
23	2.17	2059	48	1.04	4289
24	2.08	2148	49	1.02	4378
25	2.00	2234	50	1.00	4468

MOON MONTH NAMES

TRADITIONAL	NATIVE AMERICAN	JAPANESE	DRUID-CELTIC	YOURS
January	The Old Moon	Harmonious	Birch	_____
February	The Hunger Moon	Wear More	Quick Beam	_____
March	The Crow Moon	Warm Little	Ash	_____
April	The Grass Moon	Rabbit	Alder	_____
May	Planting Moon	Early	Willow	_____
June	The Flower Moon	No Water	Hawthorn	_____
July	Thunder Moon	Letter	Oak	_____
August	The Grain Moon	Leaves	Holly	_____
September	Harvest Moon	Longest	Hazel	_____
October	Hunters Moon	No Gods	Vine	_____
November	Frosty Moon	Frost	Ivy	_____
December	Long Night Moon	Final	Reed	_____
---	---	---	Elder*	

*The Druid/Celtic names are based upon tree names. There are 13 names given as their calendar was based on a lunar cycle of 29 days. Each cycle begins with the new, or no show, moon.

MOON MONTH NAMES

The Native Americans Had A Word For It

MONTH	PLAINS CREE	DAKOTA SIOUX	ASSINIBOINE	PLAINS OJIBWA	CHIPEWYAN
January	Great	Hard month	Hard time	Half-winter	Cold
February	Eagle	Raccoon	Long day	Big	Bald eagle
March	Goose	Sore-eye	Sore-eye	Goose	Wild geese
April	Frog	When geese lay eggs	Frog	Frog	Frog
May	Budding	Planting	Leas	Budding	Egg-laying
June	Hatching	Wher the strawberries are red	Red berry	Blooming	Egg fertilized
July	Moulting	When the chokecherries are red-ripe and the geese shed their feathers	Mid-summer	Unripe berry	Duckling
August	Flying-up	Harvest	Blackcherries	Ripe berry	Flying
September	1. Mating 2. Autumn	When the rice is laid up to dry	Yellow Leaf	Moose mating	Fighting of moose or deer
October	Migrating	Drying rice	The striped gopher looks back	Migrating	Freezing
November	Frost	Deer rutting	Frost	Freezing-up	Frost
December	Frost-exploding trees	Twelfth Moon	Brother To hard times	Winter begins	1. Midnight mass 2. Shortest day

DEALING WITH LARGE NUMBERS

In our studies of space, we often face rather large and uncomfortable numbers. After so many millions and trillions, the numbers begin to blur together and become meaningless. Let's see if we can make these numbers easier to understand.

Facts like these use large numbers:

* the average distance to the sun from the earth is 93,000,000.
* a light-year is around six trillion miles.
* the next nearest star is just over four light-years away.

Millions--trillions--UGH!!

What is a trillion? To help us understand this number, we will use a more familiar number: one million. One trillion by definition is one million millions. Great! How big is a million? Well, let's take some time out to get hold of a million.

There are 60 seconds to a minute and 60 minutes to an hour.

How many seconds to an hour? Answer _____

How many seconds to a day? Answer _____

How long is a million seconds? Answer _____

If you extend this idea, multiply your last answer by a million and you can see how long it takes to reach a trillion seconds.

Your answer _____

A dollar bill is six inches long. How long would a million dollar bills be? Remember there are 5,280 feet to one mile. Give your answer in miles. Answer _____

How long would a trillion dollars be? Answer _____

Measure your stride, how far you walk when you take one step. Your stride is _____.

How far would you walk in a million steps? Answer _____

How far would you walk in a trillion steps? Answer _____

Dealing with Large Numbers (continued)

Astronomers often use the unit light-year to express distances. Why? Why not simply put these distances into miles? Let's see if we can figure this out. A light-year is the distance light travels in one year. How far is this? Light travels about 186,000 miles per second. At this speed, how far will it go in one minute?

Answer _____

How far will it travel in one hour? (watch your zeros)

Answer _____

How far will it travel in one year?

Answer _____

Now you can see why it is much easier to express astronomical distances in light time units instead of miles.

NOTE: Block off the Answer Sheet when you copy for classroom use.

DEALING WITH LARGE NUMBERS -- ANSWER SHEET

How many seconds to an hour: 3600
How many seconds to a day: 86,400
How long is a million seconds: Just less than 12 days; 11.574 days to be exact.
A trillion seconds: 31,688 years approximately; 31,687.885 exact.
A million dollar bills: 94.7 miles
A trillion dollars: 94.7 million miles, farther than from here to the sun.

Light travels: 11,160,000 miles in one minute.
669,600,000 miles in one hour.
About 6 trillion miles in one year.

WHAT'S IN A NAME?

Recently we have come to know some of the moons of Jupiter and Saturn through the images sent back by Voyager. However, these objects have rather strange sounding names whose meanings are quite obscure. Let's see if we can make some sense out of them.

WHERE DO THEY COME FROM?

These strange sounding names have their roots in the lore of Greek and Roman mythology.

Amelthea:	A goat whose milk fed the baby Jupiter.
Io:	A king's beautiful daughter that Jupiter had a crush on.
Europa:	Another girlfriend of Jupiter.
Ganymede:	He was supposed to be the best looking of all mortal men.
Callisto:	A female that Jupiter changed into a bear and placed in the night sky as the Little Dipper.
Saturn.	The Roman god of time.
Dione:	The mother of Venus.
Enceladus:	A hundred-armed giant who fought against Jupiter.
Tethys:	A sea goddess.
Rhea:	The mother of Jupiter and Neptune.
Titan:	A race of early gods were called the Titans.
Hyperian:	One of the Titans. He was the father of the sun and the moon.
Iapetus:	Another Titan. He was a son of Uranus.
Phoebe:	Another Titan.

Exercise: Look up the origins of the other planet names and see what they mean.

1. The names of the planets are from ROMAN mythology. The Roman deities are based upon those deities of the Greeks. Using the names of the Greek deities, place the names of the planets in order of their distance from the sun:

Cronus	Hades	Aphrodite	Ares	Hermes
Zeus	Poseidon	Uranus	Earth	

2. As above (matching):

(A)	Mercury	1.	Aphrodite
(B)	Venus	2.	Ares
(C)	Earth	3.	Cronus
(D)	Mars	4.	Earth
(E)	Jupiter	5.	Hades
(F)	Saturn	6.	Hermes
(G)	Uranus	7.	Poseidon
(H)	Neptune	8.	Uranus
(I)	Pluto	9.	Zeus

WHERE TO SEE THE PLANETS IN 1988

MERCURY: To see this elusive planet you must have a clear sky and a good horizon free of obstacles. Mercury never gets far from the Sun and thus is very hard to find. Some people live their whole lives observing the sky and never see Mercury. From January 10 until February 4, it is visible in the western sky after sunset. It repeats this from April 28 until the beginning of June, and from August 12 until October 5. From December 18 through the end of the year it is an evening star. Mercury is a morning object from February 17 until April 10, from June 22 until July 25, and from October 20 until November 15. Look to the east in the morning times.

VENUS: The brightest of all the planets is seen in the west after sunset until the start of June, when it becomes lost in the glare of the Sun. Venus reappears in the morning in the east around June 20 and remains a morning object for the rest of the year.

EARTH: Still in the same place we've always seen it -- just look down!

MARS: This is the year for Mars! This year will be as good as it gets until the 21st century. Mars begins 1988 as a morning sight rising after midnight on January 21. It's just a hand-width away from another red object, Antares. By early June it comes up at midnight and by September 28 is up all night.

JUPITER: The largest planet begins the year as an evening object, moving slowly west. By April Jupiter becomes lost in the glare of the Sun. It reappears in mid-June near Taurus as a morning object. From July 1 until the end of the year it remains within a hand-width of the Pleiades.

SATURN: This planet is lost in the glare of the Sun as the year begins, but by late January becomes visible in the group of stars we call Sagittarius. By April Saturn comes up around midnight, and remains an evening object until mid-December, when it becomes lost again.

URANUS AND NEPTUNE:

We combine these two as they are very close to each other all year in the group of stars near Saturn. On February 12 Uranus and Neptune are but a finger-width apart. The last time Saturn and Uranus were this close in our line of sight was in 1944. On February 22 and 23 Mars comes in, forming the closest grouping of planets until the year 2006. By the way, that's the year of high school graduation for a child born in 1988.

Throughout 1988 Uranus and Neptune remain close to each other, doing a little moving back and forth through the edge of Sagittarius and Ophiuchus. On June 26 they will rise together at sunset. That will not happen again until the year 2032. On October 17 they again come close to each other and then slowly separate until well into the 21st Century. All it takes to keep tabs on this show are good binoculars, and, of course, a clear sky. Keep good drawings!

PLUTO: Forget it!

SYMBOLS

UNSCRAMBLE THE LETTERS AND DISCOVER THE PLANETS

1.) Y M E C R R U _ _ _ _ _ _ _

2.) O U L P T _ _ _ _ _

3.) H R E T A _ _ _ _ _

4.) E S U V N _ _ _ _ _

5.) J E R U T P ! _ _ _ _ _ _ _

6.) U E E N N T P _ _ _ _ _ _ _

7.) S R M A _ _ _ _

8.) A U S R T N _ _ _ _ _ _

9.) U U A R N S _ _ _ _ _ _

- PHOBOS

LESS THAN 17 MILES LONG. SHAPED LIKE A POTATO.
IS AS DARK AS A BLACKBOARD.
GRAVITY IS SO WEAK, YOU COULD THROW A BALL
INTO ORBIT AROUND IT.

- DEIMOS

9 BY 7 MILES. AS DARK AS PHOBOS. GRAVITY IS SO
WEAK YOU COULD TAKE AND PUT YOURSELF INTO ORBIT.

	SIZE	COMMENTS
ADRASTEA	14 miles?	Fastest known moon
METIS	13 miles?	
AMALTHEA	90 x 50 miles	Looks like a red potato
THEBES	27 miles?	
IO	About the size of our moon	Has active volcanoes
EUROPA	A little smaller than our moon	May have liquid water under its ice. Life???
GANYMEDE	Largest moon in the solar system	
CALLISTO	Slightly larger than our moon	Most cratered moon known
LEDA	4 miles?	Smallest known moon in the solar system
HIMALIA	67 miles	
LYSITHEA	7 miles?	Takes about one year to go around Jupiter
ELARA	35 miles	
ANANKE	7 miles?	
CARME	10 miles?	
PASIPHAE	17 miles	
SINOPE	11 miles	Most distant moon on any planet

SATURN'S LARGE FAMILY

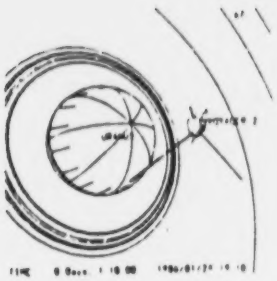
It isn't known just how many moons this planet has, and some of the moons have yet to receive an official name. The current family is listed here in order, starting with the closest satellite to Saturn and moving on out. The size given is for miles in diameter.

NAME	SIZE	COMMENTS
Atlas	25 x 13	Discovered by Voyager 1
1980S27	85 x 60	Voyager 1
1980S26	65 x 55	Voyager 1
Janus	140 x 125	Discovered in 1966
Epimetheus	90 x 75	Discovered in 1977
Mimas	190	Huge impact crater
1981S12	6?	Voyager 2 discovery
Enceladus	320	Like a cracked mirror, reflects more sunlight than any other moon
Tethys	650	Has a long valley on it
1980S13	20 x 17	Discovered in 1980 from Earth
1980S25	20 x 15	Discovered in 1980 from Earth
1981S6	12	Discovered by Voyager 2
1981S11	9?	Voyager 2 discovery
Dione	620	Has large white areas on it
1980S6	22 x 20	Discovered from Earth in 1980
Telesto	12	Discovered by Voyager 2
Calypso	9?	Discovered by Voyager 2
Rhea	960	Mixture of rock and ice
Titan	3240+	Only moon in our solar system with atmosphere
Hyperion	260 x 160	Shaped like a hamburger
Iapetus	920	One side red, the other white
Phoebe	140	Orbits around Saturn backwards

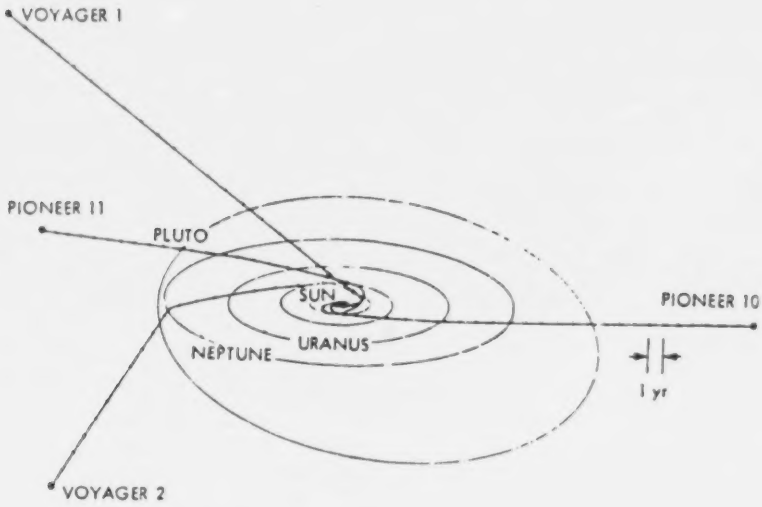
With the exception of Titan and Phoebe, all of these moons are either pure ice, or mixtures of ice and some rock. The smaller moons are most likely pure ice.

Titan is an orange covered ball, larger than either the planets Mercury or Pluto. The atmosphere contains large amounts of poisonous gases, such as methane and hydrogen cyanide.

The temperatures on these moons is well under 200 degrees below zero.



URANIAN SATELLITES



Gravity assist has deflected the two Voyagers out of the ecliptic plane. Flying "under" Saturn, Voyager 1 was lofted at a 35° angle above the ecliptic. Flying "over" Neptune, Voyager 2 will be flung beneath the ecliptic at an angle of 47°. Planet and spacecraft positions are shown in 2000 A.D.

However, minimum spacecraft power requirements appear unattainable after the year 2015, when Voyagers 1 and 2 will be at distances from the sun of 130 AU and 110 AU, respectively. Far beyond the heliopause, at the very edge of our solar system, the Voyagers will fly through Oort's cloud of cometary nuclei. However, at the cloud's great distance of 65,000 AU (about 1 light-year), the Voyagers will not arrive for another 20,000 years.

Miranda: Smallest, 100 to 200 miles. Named after a character from Shakespear's play THE TEMPEST. Revolves in less than 2 days.

ARIEL: 400 to 1500 miles. Hard to be exact. Could be full of surprises when Voyager arrives in 1986. Named after a Sylph in Popes THE RAPE OF THE LOCK. Sylphs are imaginary folks who live in the air. Takes just over two days to revolve Uranus.

UMBRIEL: 500 to 800 miles in diameter, another Sylph. Revolves in just over 4 days.

TITANIA: Discovered by Herschel, size 600 to 1500. Thought to be the satellite with the highest density in the Solar System, over 6 times the density of water. Named after the fairy queen in Shakespear's A MIDSUMMER NIGHTS DREAM. Takes about 8 days to go around.

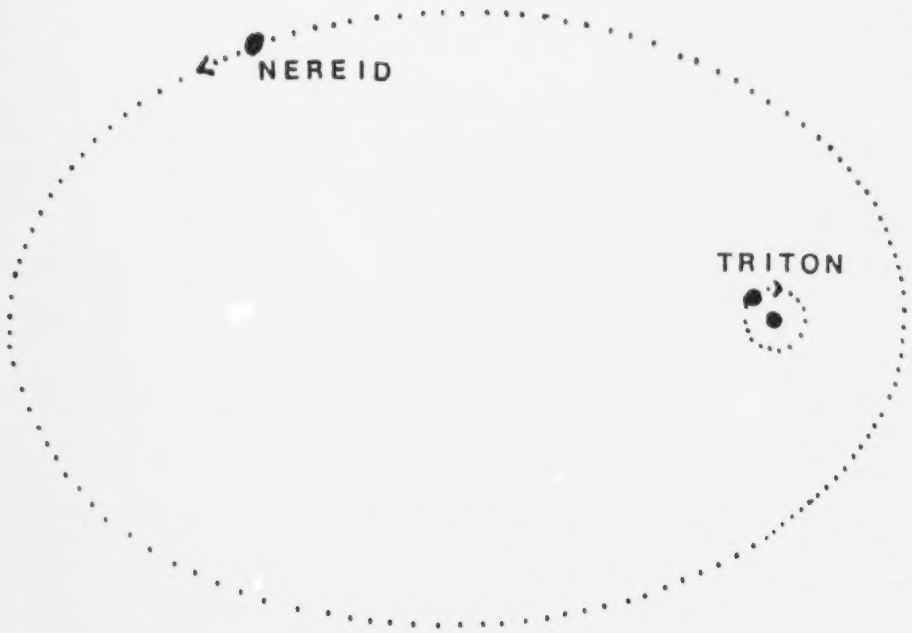
OBERON: Discovered by Herschel, 700 to 1500 miles in size. Named after the king in A MIDSUMMER NIGHTS DREAM. Revolves Uranus in 13 days.

URANUS SATELLITES

An update after the Voyager 2 flyby, January 1986.

NAME	DIAMETER (MILES)	ORBIT RADIUS IN MILES
Oberon	965	362,600
Titania	990	270,900
Umbriel	740	165,500
Ariel	725	118,700
Miranda	300	80,400
1985U1	100x105	53,400
1986U5	30?	46,660
1986U4	30?	43,450
1986U1	60?	41,070
1986U2	50?	39,990
1986U6	30?	38,960
1986U3	50?	38,370
1986U9	30?	36,720
1986U8	15?	33,120
1986U7	10?	30,630

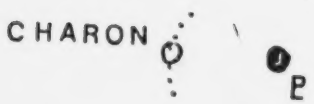
NEPTUNE'S FAMILY



Nereid is too faint to be seen through any telescope. It has a strange orbit which takes it from 867,000 miles above Neptune to over six million miles out. To go once aroung Neptune takes Nereid about one earth year. Size: about 340 miles in diameter.

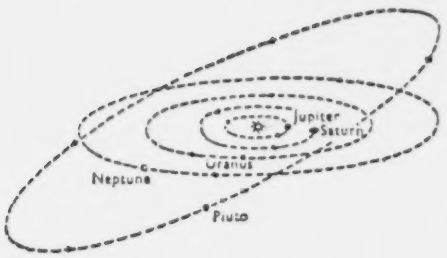
Triton is about 2300 to 3000 miles in diameter, thus larger than our moon. It orbits Neptune at about the same distance from the planet as our moon from earth,but Triton is faster; it takes only six days to go once around.

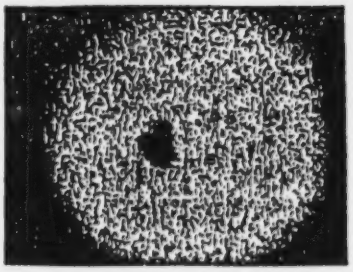
PLUTO'S CHILD



It has been calculated that Charon takes 6.4 days to orbit Pluto.

THE ORBIT OF PLUTO: 1979 - 1999





PLUTO, since its discovery in 1930, has been known as the farthest planet in our solar system. But, as of Winter 1979, and continuing until Spring 1999, Pluto does not occupy this position. During this period, Pluto's orbital motion carries it closer to the sun than Neptune and for these 20 years Neptune will be the farthest known planet.

Pluto crossed Neptune's orbit in November 1978, but due to the non-circular orbits of the two planets, it was not actually closer to the sun than Neptune until January 1979. Although the paths of the two planets cross, there is no reason for alarm. They will never collide, as they come no closer than about 1.76 billion miles to each other.

Pluto was identified by Clyde Tombaugh, at the Lowell Observatory in Arizona, in March 1930, after its existence had been predicted by Percivall Lowell. Lowell had predicted the existence of Pluto because the perturbations in the orbits of Neptune and Uranus could be best explained by postulating an extra planet. Pluto was not located, however, until 14 years after Lowell's death.

Pluto will reach perihelion (point closest to the sun) in 1989. Already it is considerably brighter than when Tombaugh discovered it in 1930. A moderate telescope will show it, though it looks exactly like a faint star. At present it lies near the boundary between Virgo and Coma Berenices; it will remain in this region for some years since its movement against the starry background is very slow.

On June 22, 1978, James W. Christy of the U.S. Naval Observatory's Exploratory Development Staff discovered a moon orbiting Pluto. This startling discovery enabled scientists to unravel some of the mysteries of this elusive planet. Pluto has a diameter of approximately 1,500 miles. Pluto's moon, Charon, is approximately 500 - 600 miles in diameter, in an orbit 12,000 miles above the planet. It orbits Pluto every 6.3 Earth days, the same time it takes the planet to turn once on its axis. It is the only satellite-planet pair with this kind of synchronized orbit, esentially allowing the moon to stay in the same place in the Plutonian sky. Looking at Charon's orbit around Pluto reveals much about Pluto's mass. This, combined with the known diameter, now tells us that the planet is very light, with a density somewhat less than water, and probably not composed of solid rock.

The above photograph (right) was taken with the U.S. Naval Observatory's 61-inch astrometric reflecting telescope. In this negative, Pluto appears as a dark spot near the center. Its moon, Charon, appears as an elongation on the upper right part of the image of the planet.

- U.S. NAVAL OBSERVATORY -

MATCH THE NAME WITH THE OBJECT

1. _ _ _ _ _ _ _ _
2. _ _ _ _
3. _ _ _ _ _
4. _ _ _ _ _ _
5. _ _
6. _ _ _ _ _
7. _ _ _ _ _ _
8. _ _ _ _ _ _ _
9. _ _ _ _ _ _ _ _
10. _ _ _ _ _

FIND THE ANSWERS BELOW. BE SURE TO SPELL THE WORD CORRECTLY!

1. This tiny moon of Jupiter is shaped like a giant red potato over 100 miles ling.
2. This planet has two tiny moons.
3. This moon of Saturn looks like an orange fuzzy ball because it has its own atmosphere.
4. One of the four large moons of Jupiter, this moon looks like a round cracked egg.
5. Another large moon of Jupiter, this object is about the size of our moon. It has active volcanoes and the color of a fresh pizza on its surface.
6. This moon of Saturn has some rather unusual surface features.
7. This tiny moon of Saturn we don't know too much about, except that it is round and it goes around Saturn backwards!
8. The closest planet to the sun.
9. This moon of Saturn is shaped like a big hamburger, very thin.
10. The only planet whose moon has no name.

WHAT'S YOUR PET MOON?

4 G	3 E	8 D	7 H	3 N	5 I	6 M
6 I	5 A	4 A	5 P	5 E	7 Y	3 C
7 P	5 T	3 E	6 M	3 L	4 N	7 E
3 A	8 I	7 R	4 Y	8 O	6 A	5 U
4 M	7 I	5 S	3 D	7 O	4 E	8 N
7 N	3 U	4 D	6 S	4 E	8 E	3 S

COUNT THE NUMBER OF LETTERS IN YOUR FIRST NAME. IF YOU HAVE LESS THAN 5, ADD 2. IF YOU HAVE MORE THAN 5, SUBTRACT 3. FOLLOW THE CHART FROM LEFT TO RIGHT AND WRITE DOWN ALL THE LETTERS THAT GO WITH YOUR NUMBER AND DISCOVER YOUR PET MOON.

QUESTIONS:

1.) WHICH PLANET DOES YOUR MOON BELONG TO?

2.) WHAT DOES THE NAME OF YOUR MOON MEAN?

3.) WHAT CAN YOU SAY ABOUT YOUR MOON?

OUR SOLAR SYSTEM: FIND THE HIDDEN WORDS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	P	H	O	B	O	S	C	D	M	E	R	C	U	R	Y
2	M	A	R	S	E	D	E	M	Y	N	A	G	E	E	T
3	S	O	L	E	D	A	R	I	O	C	C	U	L	T	I
4	A	M	A	L	T	H	E	A	S	E	O	L	P	I	C
5	P	E	R	I	A	P	S	I	S	M	A	R	M	P	I
6	O	T	U	L	P	S	O	R	E	H	I	R	E	U	R
7	G	E	O	G	R	A	P	H	O	S	R	C	T	J	T
8	E	L	Y	S	I	T	H	E	A	E	I	O	A	H	N
9	E	N	C	K	E	U	R	A	N	U	S	N	A	M	E
10	D	I	E	L	A	R	A	I	S	E	U	M	M	L	C
11	I	T	I	T	A	N	S	U	N	S	P	O	T	V	C
12	O	B	E	R	O	N	U	J	O	G	O	T	E	O	E
13	N	O	I	R	E	P	Y	H	M	N	U	N	U	B	A
14	E	E	O	S	N	A	J	O	R	T	U	S	E	N	G
15	L	C	M	A	G	N	E	T	O	S	P	H	E	R	E

Hidden in the matrix above are the planets, moons, asteroids, comets, etc., which relate to the study of our solar system. Some are written forward, some backward, some up, some down, and some diagonally. Have fun!!!

MATH MESSAGE

KEY:					
	A = 27	F = 64	K = 42	P = 24	U = 20
	B = 54	G = 56	L = 35	Q = 90	V = 9
	C = 81	H = 32	M = 28	R = 12	W = 8
	D = 18	I = 16	N = 21	S = 10	X = 11
	E = 45	J = 49	O = 36	T = 15	Y = 0
					Z = 61

PUT THE CORRECT NUMBER AND LETTER UNDER EACH PROBLEM TO READ THE MESSAGE.

3	6	9	3	8	9	6
x 3	x 6	x 0	x 9	x 7	x 5	x 2

30	64	72	8	5
÷ 2	÷ 8	÷ 2	x 2	x 2

6	7	5	8	9	8	9	8	
x 6	x 3	x 3	x 4	x 5	x 1	x 3	x 0	

5	6	3	5	6	3	10	7	9
x 3	x 6	x 7	x 9	x 4	x 5	x 2	x 3	x 5

WITH A LITTLE IMAGINATION....

I THE VOYAGER PICTURE IS INCOMPLETE. YOU MIGHT DO ONE OF THE FOLLOWING:

A. DRAW IN AND COLOR AN OBJECT THAT VOYAGER SAW. I.E., JUPITER, OR ONE OF ITS MOONS, LIKE PERHAPS Io, WHICH IS VERY COLORFUL.

B. DRAW WHAT VOYAGER II MIGHT SEE IN THE FUTURE AS IT PASSES URANUS OR NEPTUNE.

C. DRAW WHAT VOYAGER SEES RIGHT NOW. (DEEP SPACE WITH STARS AGAINST A BLACK ENDLESS SKY.)

D. DRAW A VOYAGER ENCOUNTER WITH ANOTHER STAR SYSTEM MILLIONS OF YEARS FROM NOW.

II AND NOW THE WEATHER REPORT...

USING THE LIBRARY FOR HELP, SELECT A PLANET AND MAKE UP A WEATHER REPORT FOR A TYPICAL DAY. BE SURE TO INCLUDE A POSSIBLE HIGH TEMPERATURE FOR TODAY AS WELL AS THE WIND AND CHANCE FOR RAIN...OR SNOW. EITHER WRITE IT UP TO LOOK LIKE A REPORT IN THE NEWSPAPER OR DELIVER IT TO THE CLASS, LIKE ON T.V. ANOTHER OPTION IS TO RECORD IT AND PLAY IT BACK LIKE IT WAS A RADIO REPORT.

III HOW MUCH DO YOU WEIGH ON MARS??

TO FIGURE OUT HOW MUCH YOU WEIGH ON MARS OR ANY OF THE PLANETS WITH SURFACES, MULTIPLY YOUR WEIGHT BY THE NUMBER GIVEN. TO DO THIS, YOU MUST KNOW THE FOLLOWING:

A. WHAT THE SYMBOL STANDS FOR.

B. YOUR WEIGHT ON ⊕ .

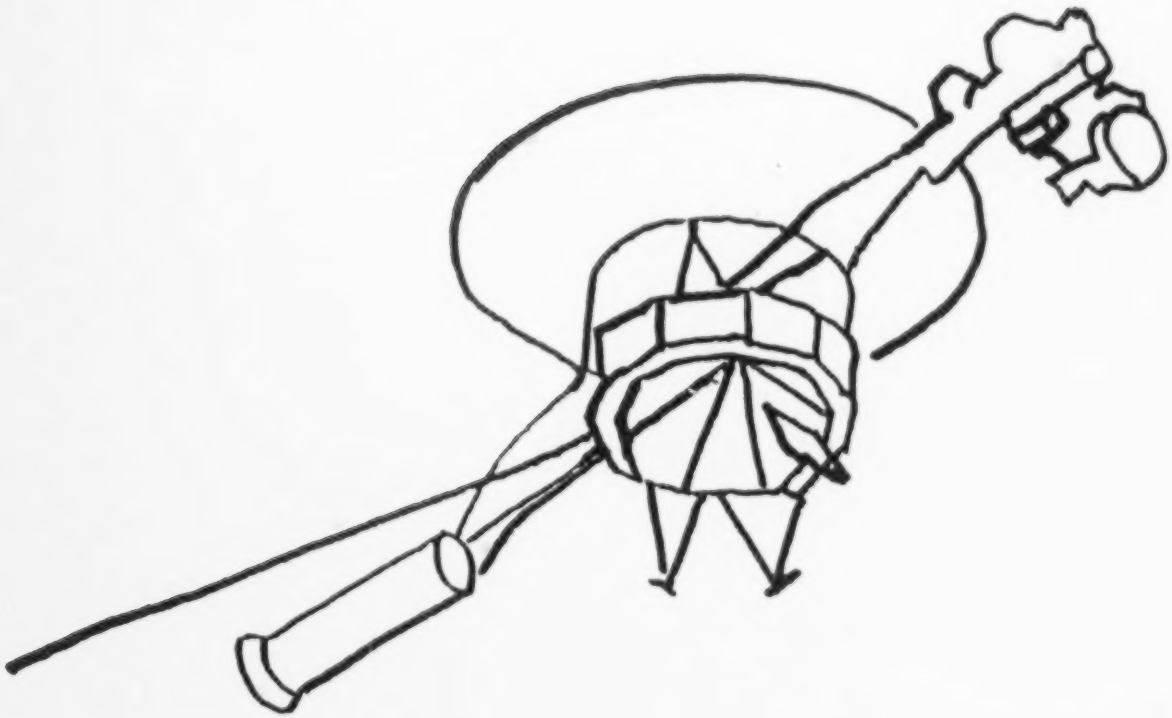
C. WHAT TO DO WITH THAT LITTLE DOT (DECIMAL POINT) BEFORE EACH NUMBER.

1. ☿ = .37 X YOUR WEIGHT
2. ♀ = .9 X YOUR WEIGHT
3. ♂ = .38 X YOUR WEIGHT
4. TITAN = .14 X YOUR WEIGHT
5. EARTH'S MOON = .16 X YOUR WEIGHT

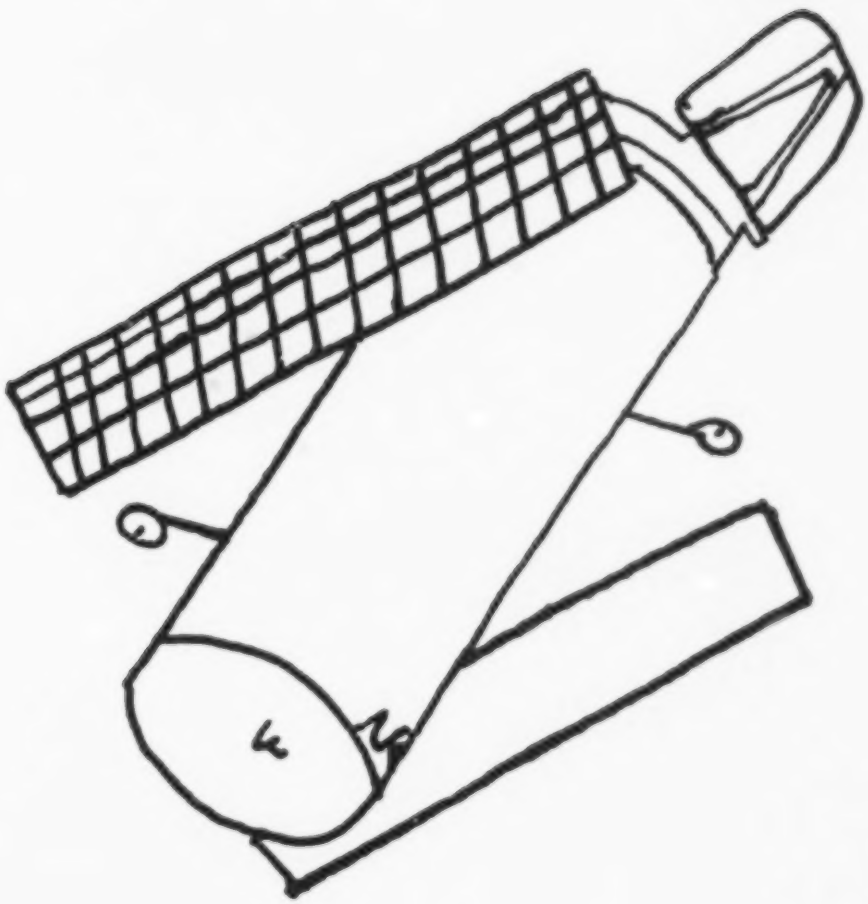
IV THE SPACE TELESCOPE PICTURE IS INCOMPLETE. DRAW IN THE EARTH.

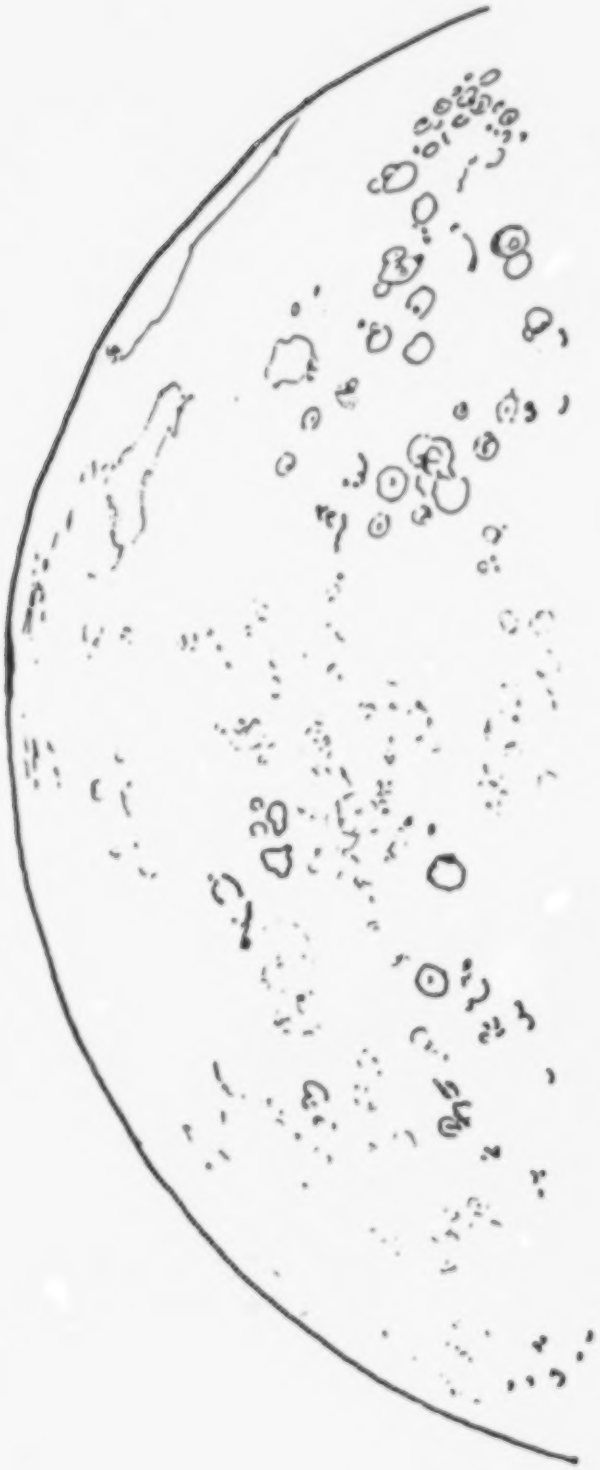
VOYAGER II/IMAGINATION PAGE

"NOW VOYAGER, SAIL FORTH...TO SEEK AND FIND"...WHITMAN



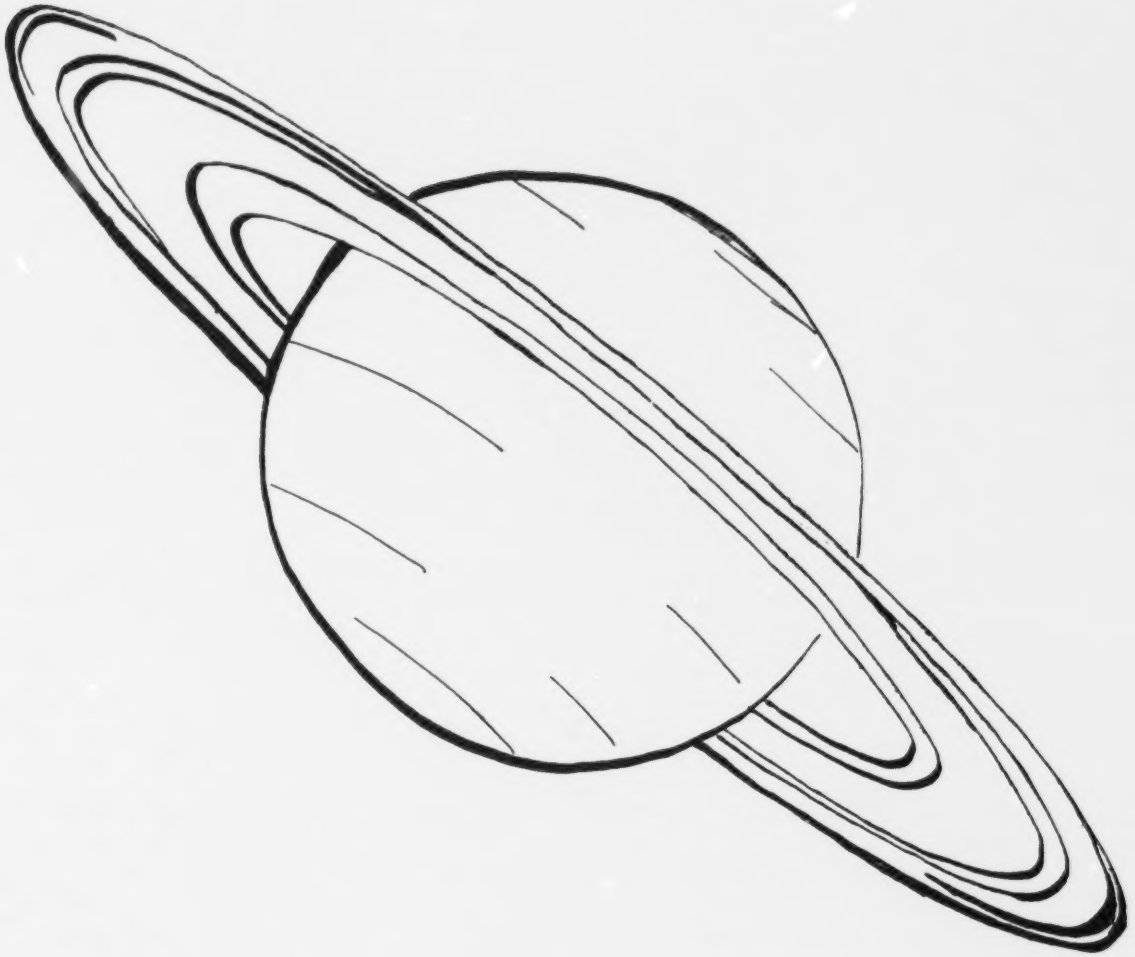
SPACE TELESCOPE

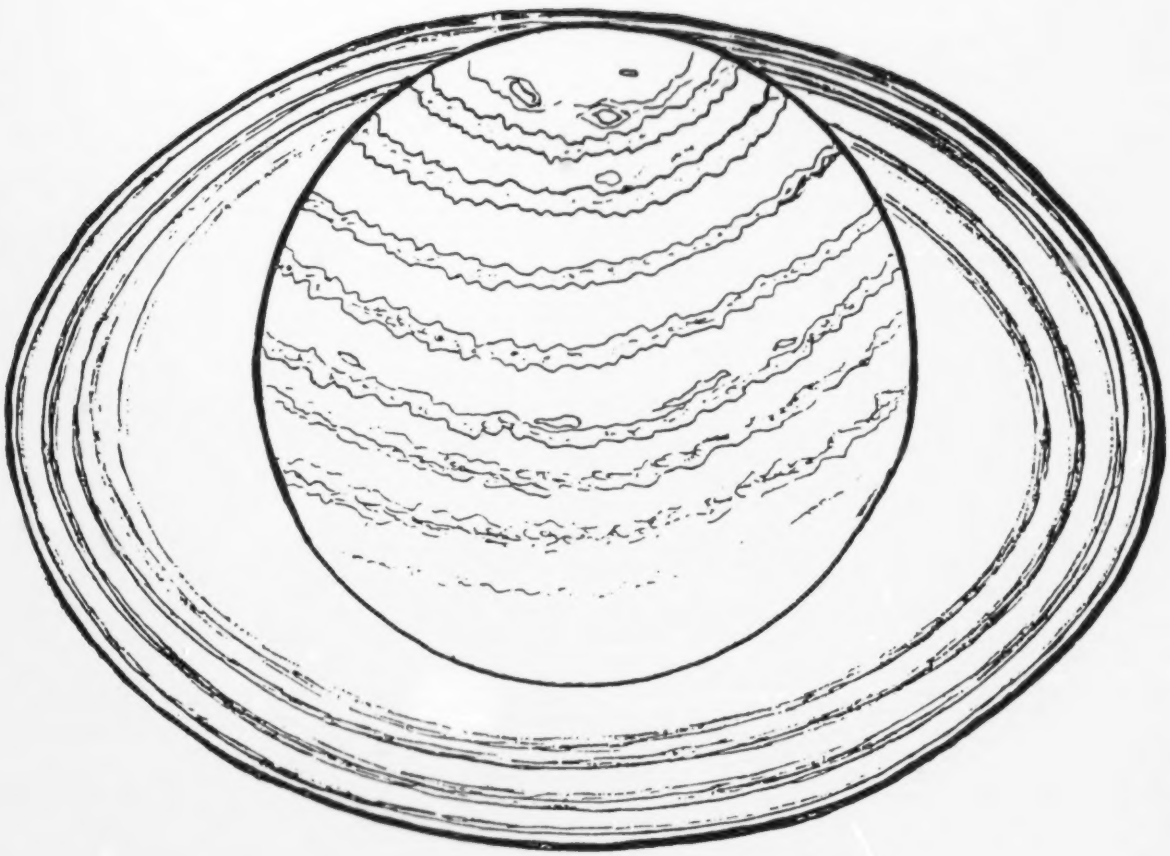


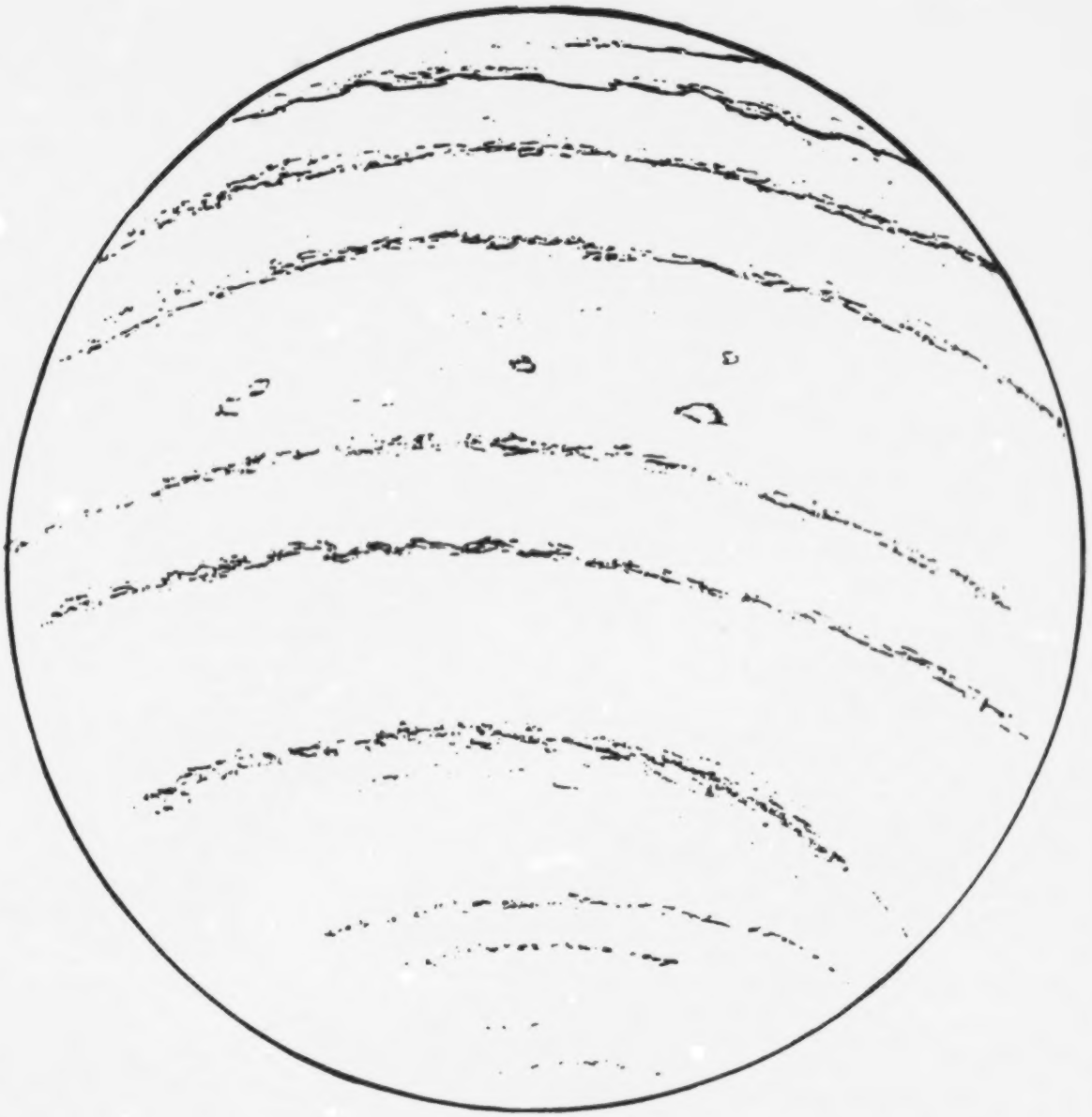


☿

4







♆

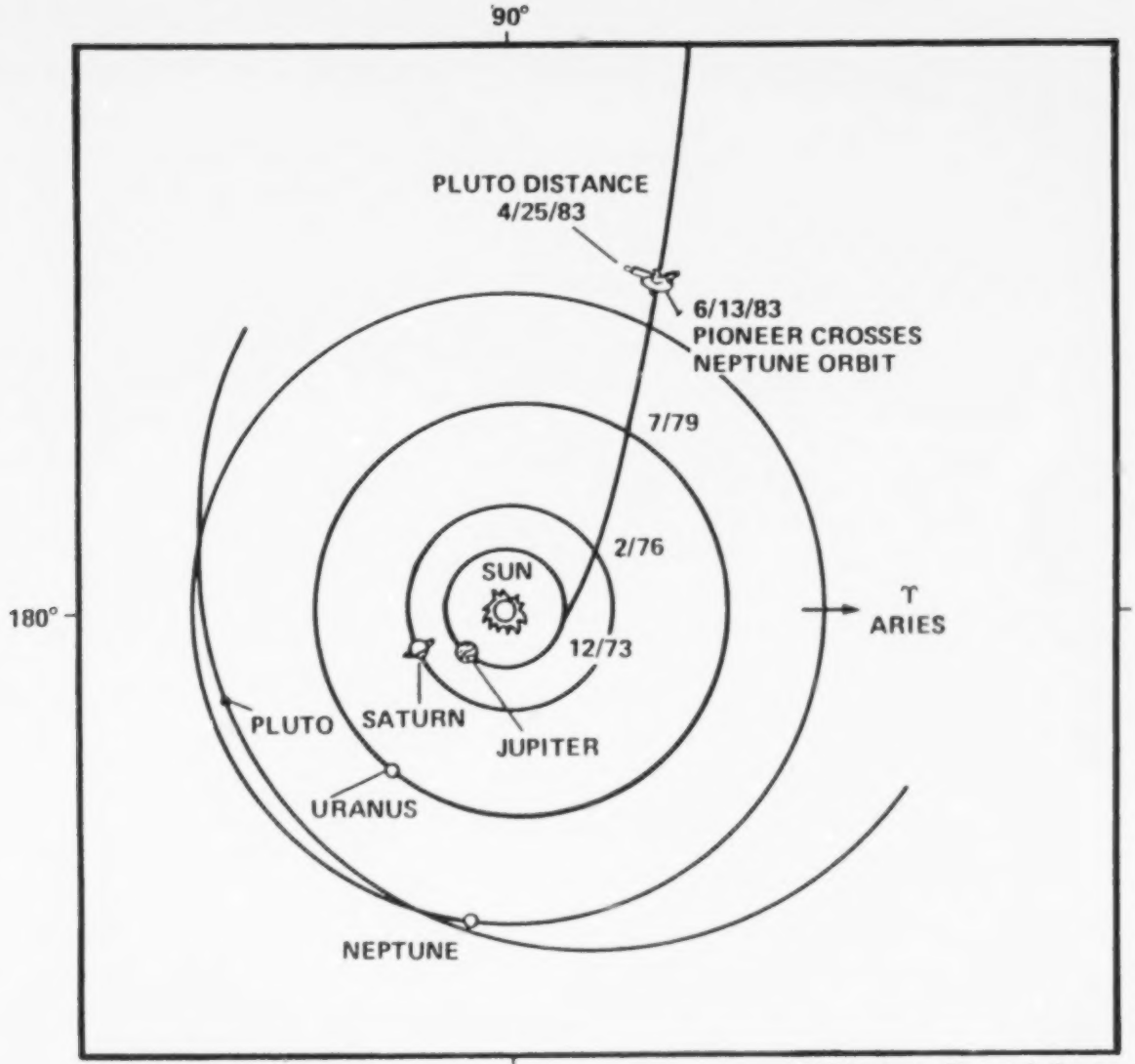
24

HOLD UP AND
VIEW FROM AFAR

⊕ EARTH, RED SEA AREA

COLOR BY NUMBER:
1-BLACK 4-GRAY
2-PURPLE 5-LIGHT BLUE
3-BROWN NO NUMBER-LEAVE WHITE

PIONEER 10 BEYOND KNOWN PLANETS



NASA Ames Research Center
March 1983

(a) STARS BETWEEN ± 50° DECLINATION

(b) SOUTH POLAR STARS

The departure directions of the escaping spacecraft are shown as time-varying traces plotted against the current stellar background of stars in Earth equatorial coordinates. In the tens-of-thousands of years that the spacecraft will take to approach even the closest star, the stellar background will have greatly changed because the stars and our own Sun are in ceaseless motion throughout the galaxy.

KEEPING CURRENT

Prices are subject to change. Don't get your hopes up for them to go down.

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Keeping Current (continued)

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Cost . . . $7.50 includes shipping, handling, postage. 200 pages of detailed descriptions of educational resources.

MISCELLANEOUS

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Slides, Posters, Etc.
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Philadelphia, PA 19143

Astrophotography Equipment
Robert T. Little
PO Box E
Brooklyn, NY 11202

T-shirts
Cotton Expressions
832 West Junior Terrace
Chicago, IL 60613

NASA Information Summaries

National Aeronautics and
Space Administration
Washington, D.C.
20546
PMS-006/5-86

Source List

This list represents possible sources of items from independent concessionaires and entrepreneurs, not available from the National Aeronautics and Space Administration, and is offered without recommendation or endorsement by NASA. Inquiry should be made directly to the appropriate source to determine availability, price, and time required to fill orders before sending money.

Scientific and Technical Information (Mission Reports):

National Technical Information Services, 5285 Port Royal Road, Springfield, VA 22151
Scientific and Technical Information Facility, 800 Elkridge Landing Road, Linthicum Heights, MD 21090

Spacecraft and Airplane Models:

Models of spacecraft and aircraft may be purchased at hobby shops and toy departments of your local department stores, and also at some of the companies listed below. The following firms are model-rocket manufacturers:

Estes Industries, PO Box 227, Penrose, CO 81240
Revell, Inc., 4788 Glencoe Avenue, Venice, CA 90291
Flight Systems, Inc., 9300 East 68th Street, Raytown, MO 64133
Pacific Miniatures, Inc., 817 South Palm Avenue, Alhambra, CA 91803
Monogram Models, Inc., Morton Grove, IL 60053
Custom Graphics, PO Box 2176, Altamonte Springs, FL 32715
Toys and Models Corporation, 222 River Street, Hackensack, NJ 07601
Wesco Models, Inc., 1453 J Virginia Avenue, Baldwin Park, CA 91706
Scale Models, Inc., 111 Independence Drive, Menlo Park, CA 94025
Move Miniatures, 5115 Douglas Fir Drive, Suite F, Calabasas, CA 91302

Souvenirs and memorabilia commemorating space, such as Cameras, Text Books, Photograph Albums, Emblems, Patches, Decals, Commemorative Medals, Flight Jackets, T-Shirts, Caps, Buttons, etc.:

AW/JSC Exchange Store, Johnson Space Center, Houston, TX 77058
Alabama Space and Rocket Center, Tranquility Base, Huntsville, AL 35807
Space Age Enterprises, PO Box 58127, Houston, TX 77058
National Medallion Company, Inc., PO Box 58127, Houston, TX 77058
KSC Tours, TWA Services, Inc., TWA-810, Kennedy Space Center, FL 32899
Communications Association Corporation, 250 Babcock Street, Melbourne, FL 32935
Smithsonian Institution Museum Shops, 900 Jefferson Drive SW, Washington, DC 20560
NASA Headquarters Exchange Store, 600 Maryland Avenue SW, Washington, DC 20546
Action Packets, Inc., 344 Cypress Road, Ocala, FL 32672
International Space Hall of Fame Gift Shop, PO Box 25, Alamogordo, NM 88310
GEWA Visitor Center Gift Shop, Goddard Space Flight Center, Greenbelt, MD 20771
Space Art: Original Paintings & Prints, Blalch Museum, PO Box 584, Rockledge, FL 32955-0584
Johnson and Associates, PO Box 46251, Pentagon, Washington, DC 20050

Space Suits:

ILC Dover, Box 266, Frederica, DE 19946
Hamilton Standard, Windsor Locks, CT 06096

Stamps:

JSC Stamp Club, PO Box 58328, Houston, TX 77058
Houston Hobby Center, PO Box 10791, Houston, TX 77018
GEWA Visitor Center Gift Shop, Goddard Space Flight Center, Greenbelt, MD 20771

Maps: Moon, Mars, etc.:

Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402
National Geographic Society, PO Box 2806, Washington, DC 20036
U.S. Geological Survey, Department of the Interior, 1200 South Eads Street, Arlington, VA 22202
GEWA Visitor Center Gift Shop, Goddard Space Flight Center, Greenbelt, MD 20771

Photographs, Slides, etc.:

AW/JSC Exchange Store, Johnson Space Center, Houston, TX 77058
Astronomical Society of the Pacific, 1290 24th Avenue, San Francisco, CA 94122
Woodstock Products, Inc., PO Box 2519, Beverly Hills, CA 90213
GEWA Visitor Center Gift Shop, Goddard Space Flight Center, Greenbelt, MD 20771

8mm and 16mm NASA Films:

National Audio Visual Center (GSA), Washington, DC 20409

Space-Type Freeze-Dehydrated Foods:

Oregon Freeze-Dry Foods, Inc., PO Box 1048, Albany, OR 97321
Sam Andy Foods, PO Box 1120, Colton, CA 92324
Freeze Dry Products, 321 Eighth Street, NW, Evansville, IN 47708
G. Armanno & Sons, Inc., 1970 Carroll Avenue, San Francisco, CA 94124
Flight-A-Way Foods, PO Box 184, Edinglon, TX 78539
Spaceland Enterprises, PO Box 775, Merritt Island, FL 32952
Sky-Lab Foods, Inc., 177 Lake Street, White Plains, NY 10604
GEWA Visitor Center Gift Shop, Goddard Space Flight Center, Greenbelt, MD 20771

Solar System Information, Charts, etc.:

The Hansen Planetarium, Department F, 1098 South 200 West, Salt Lake City, UT 84101
Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge, MA 02138
Astronomical Society of the Pacific, 1290 24th Avenue, San Francisco, CA 94122
GEWA Visitor Center Gift Shop, Goddard Space Flight Center, Greenbelt, MD 20771

Special Sources:

Abstracts of technical reports on imagery from Earth Resources Satellites (LANDSAT) funded by NASA, prepared and distributed by National Technical Service of Department of Commerce as a weekly bulletin; abstracts on NASA-owned inventions available for licensing:

U.S. Department of Commerce
National Technical Information Services
Springfield, VA 22161

LANDSAT photographs and digital products are available from:

Technology Applications Center University of New Mexico Albuquerque, NM 87106	specializes in remote sensing technology
EOSAT c/o EROS Data Center Sioux Falls, SD 57198	LANDSAT
National Climatic Center NOAA Environmental Data Services Federal Building Asheville, NC 28801	data in oceanographic, hydrologic, and almospheric sciences
Western Aerial Photograph Laboratory Agricultural Stabilization & Conversation Service U.S. Department of Agriculture 2502 Parley's Way Salt Lake City, UT 84109	agriculture imagery and data

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Space Camp Information

Alabama Space & Rocket Center
Space Camp Application
Tranquility Base
Huntsville, AL 35807

Power Factor Controller Distributor

Energy Vent, Inc.
915 Valley Street
Dayton, OH 45404

The Teacher In Space Foundation is a private non-profit foundation established by the 112 NASA Teacher In Space Finalists to foster the "pioneer space-age spirit in American education."

Teacher In Space Foundation
1110 Vermont Avenue, NW
Suite 710
Washington, DC 20005

The Young Astronaut Council is a private sector educational program, created by the President, which focuses on improving the math and science skills of elementary and junior high school students.

Young Astronaut Council
1211 Connecticut Avenue, NW
Washington, DC 20036

NASA Regional Center Education Offices

To request NASA educational services, please contact the Education Officer at the NASA Center that serves your state or territory.

If you live in	Write to the Education Office at	Teacher Resource Center
Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming	NASA Ames Research Center Moffett Field, CA 94035	NASA Jet Propulsion Laboratory Attn: Science & Mathematics Teaching Resource Center Mail Stop: 180-205 Pasadena, CA 91109 (818) 354-6916
Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont	NASA Goddard Space Flight Center Greenbelt, MD 20771	NASA Goddard Space Flight Center Attn: Teacher Resource Laboratory Mail Stop: 130.3 Greenbelt, MD 20771 (301) 344-8981
Colorado, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas	NASA Lyndon B. Johnson Space Center Houston, TX 77058	NASA Lyndon B. Johnson Space Center Attn: Teacher Resource Room Mail Stop: AP-4 Houston, TX (713) 483-3455 or 4433
Florida, Georgia, Puerto Rico, Virgin Islands	NASA John F. Kennedy Space Center Kennedy Space Center, FL 32899	NASA John F. Kennedy Space Center Attn: Educators Resource Laboratory Mail Stop: ERL Kennedy Space Center, FL 32899 (305) 867-4090 or 9383
Kentucky, North Carolina, South Carolina, Virginia, West Virginia	NASA Langley Research Center Langley Station Hampton, VA 23365-5225	NASA Langley Research Center Attn: Langley Teacher Resource Center Mail Stop: 164 Hampton, VA 23365-5225 (804) 865-4468
Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	NASA Lewis Research Center 21000 Brookpark Rd. Cleveland, OH 44135	NASA Lewis Research Center Attn: Teacher Resource Center Mail Stop: 8-1 Cleveland, OH 44135 (216) 267-1187
Alabama, Arkansas, Iowa, Louisiana, Missouri, Tennessee	NASA George C. Marshall Space Flight Center Marshall Space Flight Center, AL 35812	Alabama Space and Rocket Center Attn: Teacher Resource Room Tranquility Base Huntsville, AL 35807 (205) 837-3400, ext. 36
Mississippi	NASA National Space Technologies Laboratories Building 1200 NSTL, MS 39529	NASA National Space Technologies Laboratories Attn: Teacher Resource Center Building 1200 NSTL, MS 39529 (601) 688-3338

*U.S. GOVERNMENT PRINTING OFFICE: 1990 _ 748 _ 158 / 00214

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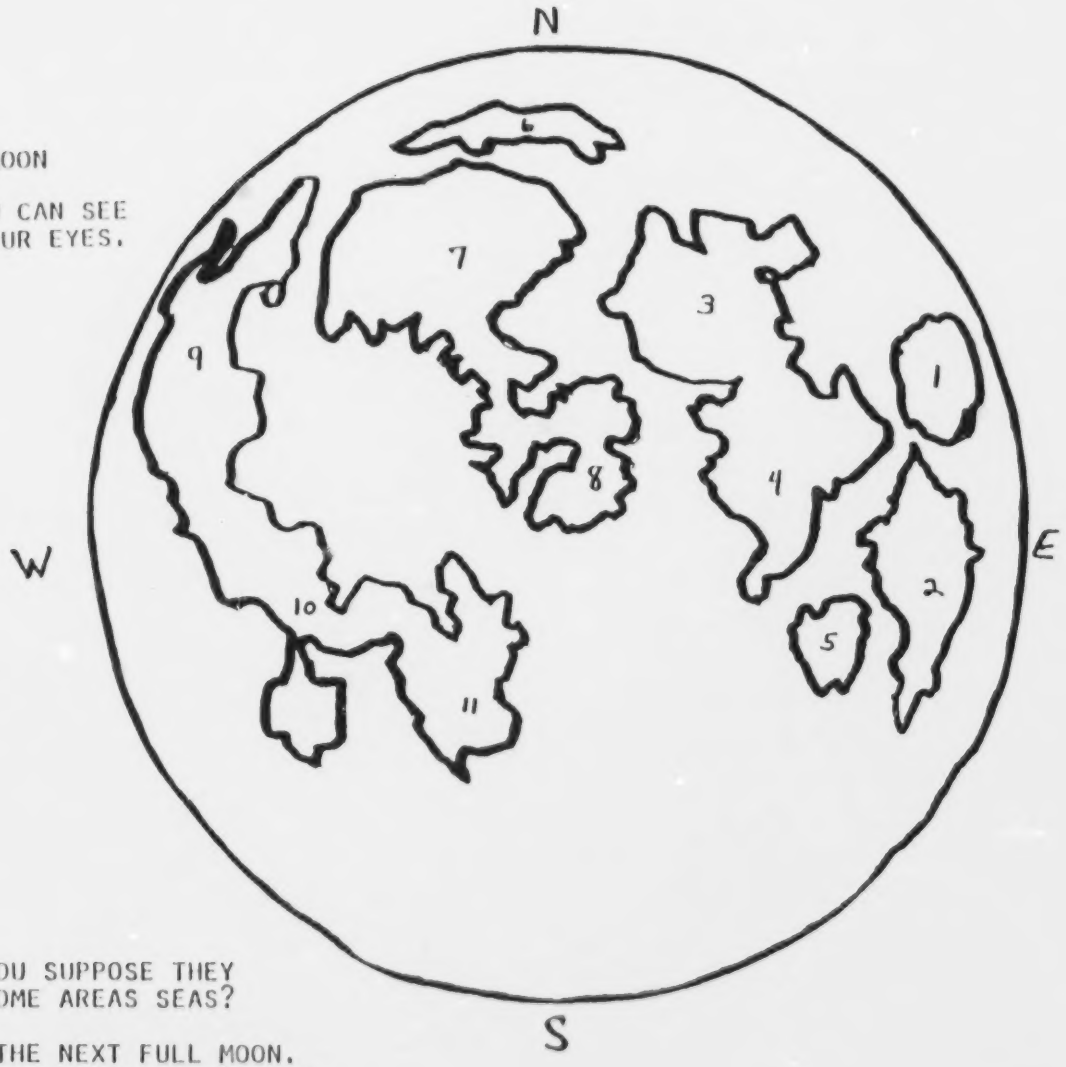
MEMORIZE OUR MOON

FEATURES YOU CAN SEE WITH JUST YOUR EYES.



NAMES

1. SEA OF CRISIS
2. SEA OF FERTILITY
3. SEA OF SERENITY
4. SEA OF TRANQUILITY
5. SEA OF NECTAR
6. SEA OF COLD
7. SEA OF SHADOWS
8. SEA OF VAPORS
9. SEA OF STORMS
10. SEA OF CLOUDS
11. SEA OF MOISTURE

QUESTIONS

1. WHY DO YOU SUPPOSE THEY CALLED SOME AREAS SEAS?

2. LOOK AT THE NEXT FULL MOON. ARE THERE OTHER FEATURES YOU COULD PUT IN ON THIS PICTURE?

OPTIONAL

COLOR IN THIS PICTURE AS IT LOOKS TO YOU..THE NEXT FULL MOON.